Blue OLEDs fabricated by Close-space sublimation

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Close-space sublimation (CSS) method presents its potential as an alternative deposition method over the conventional vacuum thermal evaporation (VTE) in organic-light emitting diode (OLED) fabrication, including high material utilization yield (>90%), short deposition time, and low vacuum chamber maintenance.[1] However, a study on the evaporation behavior of materials in the CSS process and the performance of CSS devices have not been fully established.

In our previous work, a CSS process was established by transferring an organic thin-film pre-coated on a donor sheet, upon heating, to a receiver substrate held in close proximity (Figure 1).[2] More importantly, we noticed that the CSS method was also particularly useful for the deposition of the emitting layer (EML) with a desired host-dopant composition.[3] Using the flash-heating setup, the CSS of a 30nm, 7% BD-doped BH film was completed in less than 2s. The PL spectrum of the resulting BH-BD film, as shown in Figure 2, is near identical to the VTE-deposited reference. We cannot observe the host emission in the PL spectrum even with an aluminum quenching layer on top of the CSS film. These results suggest that under the CSS condition, BH and BD formed a well-doped emitting layer without significant segregation.

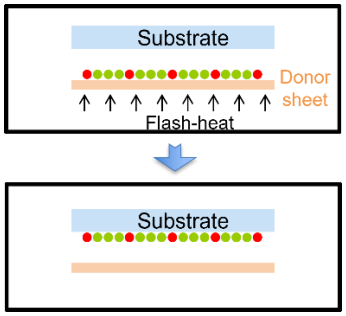

Fig. 1. Schematics of the CSS process.

We fabricated blue OLED devices of the following layer structure ITO|HATCN (10 nm)|HTL (40 nm)|EML (30 nm)|ETL (30 nm)|Liq (2 nm)|Al, where EML was BH:BD (7%) deposited by CSS. The other layers were deposited by VTE. The CSS device and the donor film were always kept under a vacuum or inert atmosphere during the whole process. A reference device sitting next to the CSS device was also fabricated entirely by VTE at the same time. As shown in Figure 3, the efficiency of the blue OLED device with a CSS-deposited EML shows 5% higher external quantum efficiency (EQE). The CSS device also demonstrates a longer T_{90} than the VTE reference, which demonstrate the merit and potential of the CSS method as a promising deposition technology in OLED fabrication.

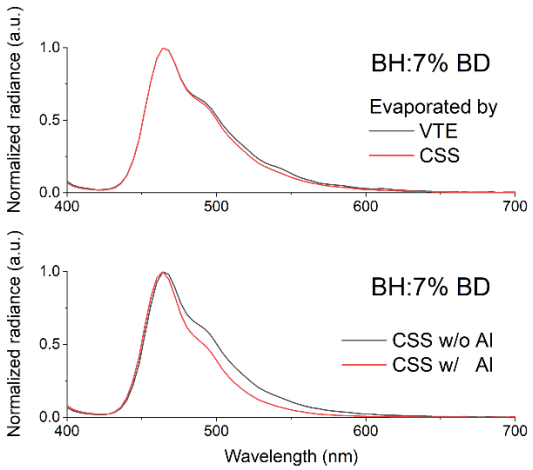

Fig. 2. Normalized PL spectra of CSS and VTE-deposited BH-BD**.**

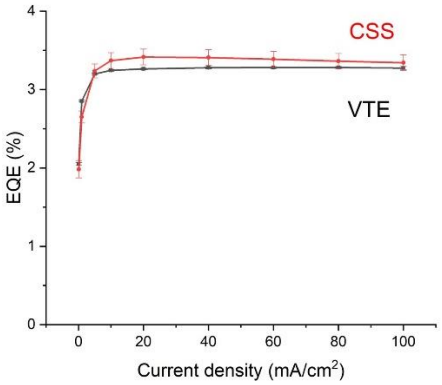

Fig. 3. EQE of CSS and VTE blue devices.

References

[1] C. Hwang, S. S. Kim, S. W. Bang, et al., *SID'18 Symposium Digest*, vol. 49, p. 1003-1006 (2018).

[2] S. T. Tam, S. C. Dong, C. W. Tang, *SID'18 Symposium Digest*, vol. 49, p. 737-739 (2018).

[3] B. S. T. Tam, S. C. Dong, C. W. Tang, *SID'19 Symposium Digest*, vol. 50, p. 153-156 (2019).